High-Contrast Brillouin and Raman Micro-spectroscopy for Simultaneous Mechanical and Chemical Investigation of Microbial Biofilms.

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Biofilm forming microbial cells characterize for their ability to grow onto solid surfaces embedded in a polymer matrix of eso-polysaccharides (EPS) and their resistance to the actions of many chemical and physical agents. In particular, biofilm forming yeast species represent both a threat for human health and a problem in food industry.
The importance of biofilms of fungal, bacterial and mixed origin depends on their increased resistance to antibiotics, anti-fungal drugs and extreme conditions. The mechanical characteristics of the biofilm, although are poorly studied, appear of primary interest to elucidate the mechanisms governing the stability and the dispersion of the cells involved in the biofilm. Hence the importance to study biofilms.
Candida strains selected for their different ability to form biofilms were grown on top of aluminum foil and stainless steel washers. Brillouin-Raman micro-spectroscopy (BRMS) performed with a new tandem Fabry-Perot interferometer was applied to map samples of *Candida* biofilms with the aim of obtaining proof of principle on the possibility to characterize mechanical (viscoelastic) and chemical properties of biofilms at high resolution [1, 2].
Chemo-mechanical maps of *Candida* biofilms were obtained without the need of staining or touching the sample. Correlation studies between Raman and Brillouin data suggested the role of both extracellular polymeric substances and of hydration water in inducing a marked local softening of the biofilm. In particular, BRMS allowed establishing the different water content in *C. albicans* biofilm as compared to *C. parapsilosis* and *C tropicalis* biofilms. The sensitivity of the method and the possibility to perform correlation studies with minimal analytical variability in the sample open the way to compare the ability of different microorganisms to survive in inhospitable environments and develop resistance to antibiotics.
Overall, we obtained proof-of-concept that joined micro-Raman and micro-Brillouin techniques allow exploring the physical and chemical properties of biofilms at high resolution in the same sample area, concurrently. This contactless detection method to characterize mechanical (viscoelastic) and chemical properties of biofilms enables the comparison of microbial biofilms.

References

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